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Domino et al.

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(54) **SINGLE SIDE ENTRY CONTAINER LIFTING DEVICE**

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(73) Assignee: **United States of America as represented by the Secretary of the Navy**, Washington, DC (US)

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(52) **U.S. Cl.** **414/662**; 414/561; 414/628; 414/640; 414/664; 212/319; 212/348
(58) **Field of Search** 414/495, 561, 414/628, 629, 639–642, 662, 664, 667, 668, 671, 673; 212/319, 327, 330, 348, 349

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(57) **ABSTRACT**

A lifting apparatus including a horizontal framework having a connector connected to a bridge crane trolley and a motor mounted on the horizontal framework, a telescoping mast unit coupled to one side of the horizontal framework and having upper, middle, and lower mast assembly and adjusting a height of the lifting apparatus, a fork tine assembly adjusting the tine center to center distance, and a counterbalance coupled to the other side of the horizontal framework is provided. The horizontal framework is coupled to an overhead bridge crane and is accessible to any load located within a minimum amount of aisle space.

13 Claims, 6 Drawing Sheets

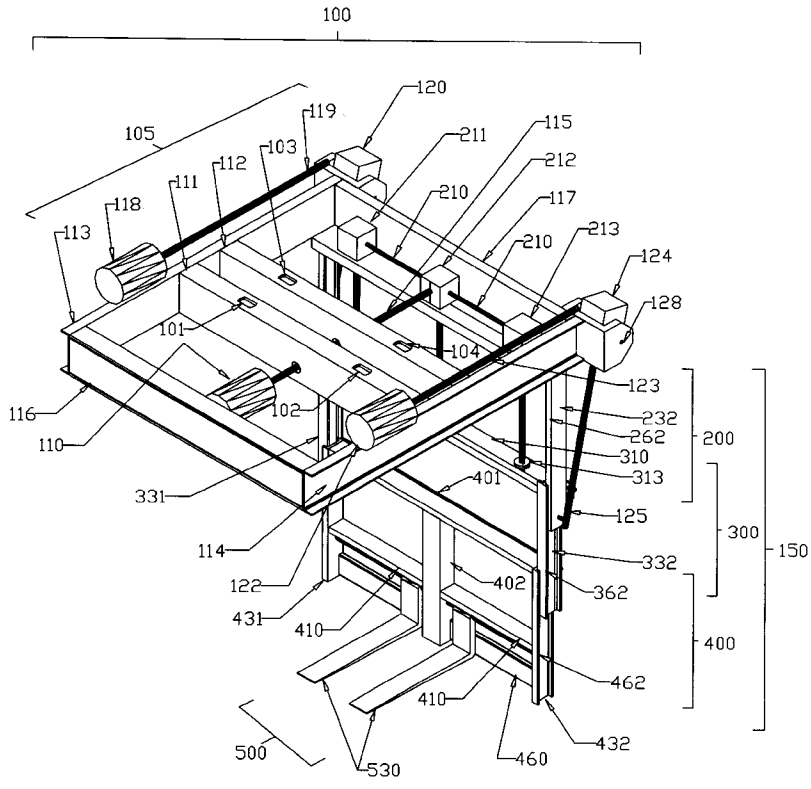

FIG. 1

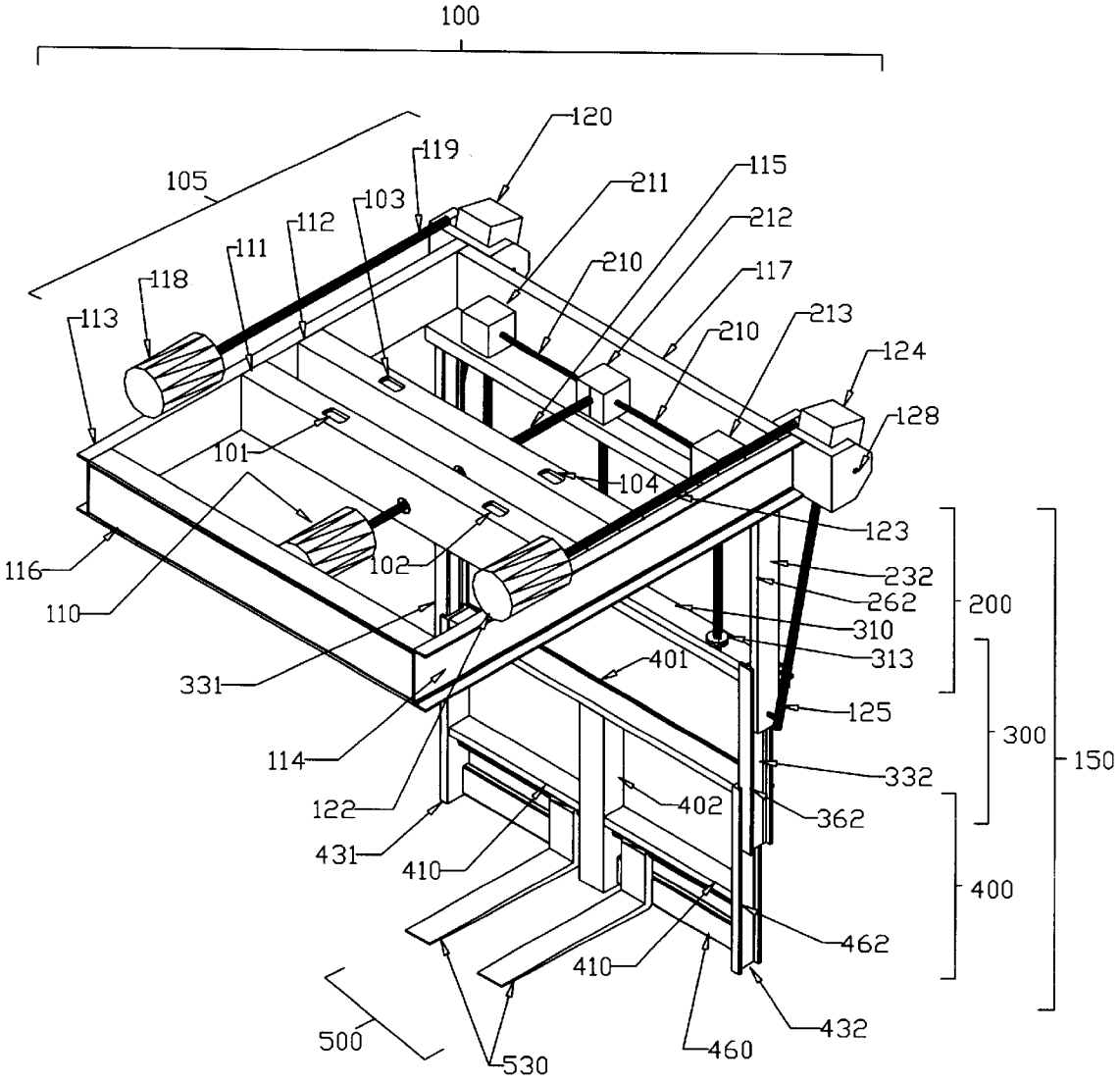
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FIG. 2

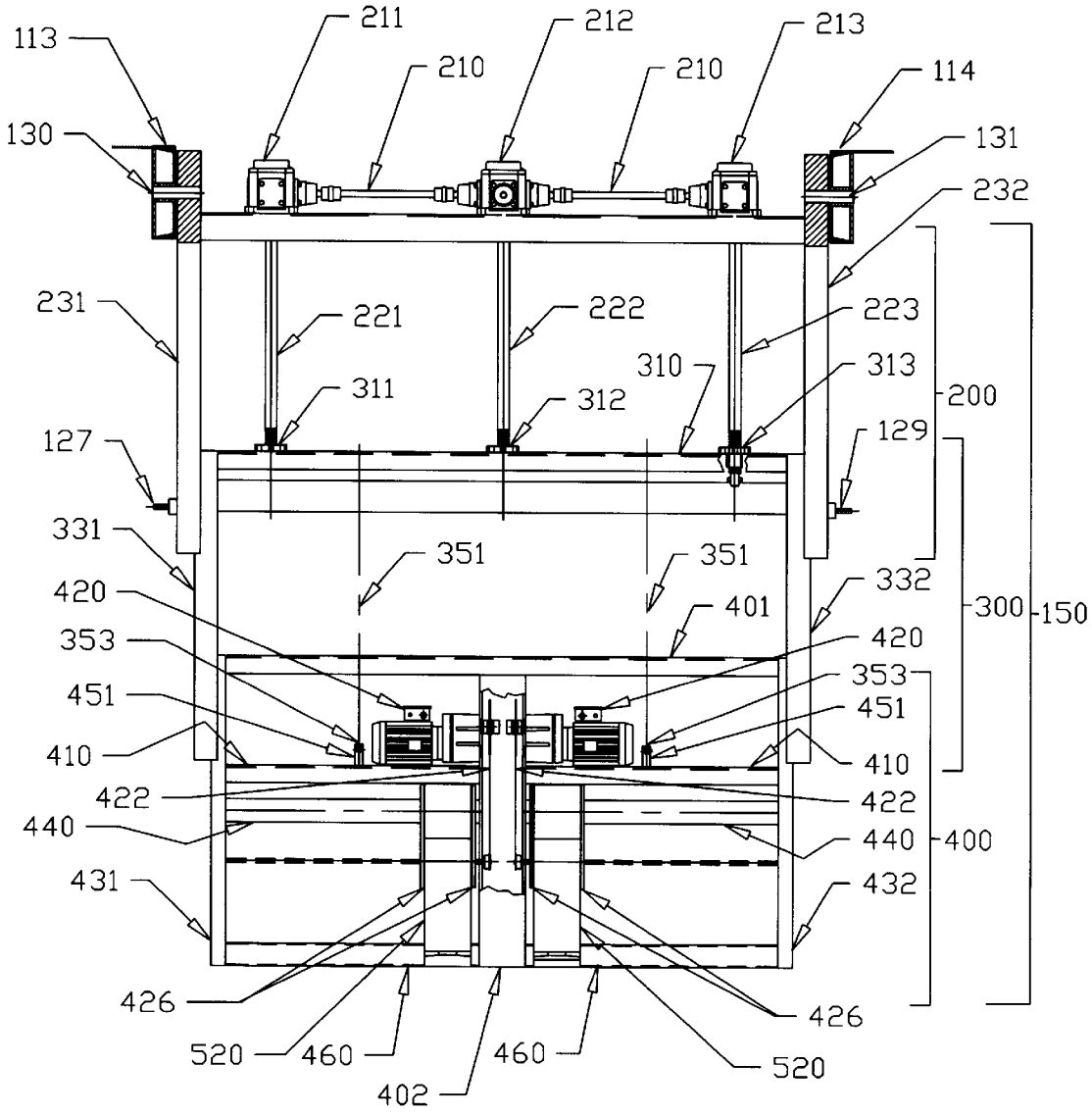
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FIG. 3

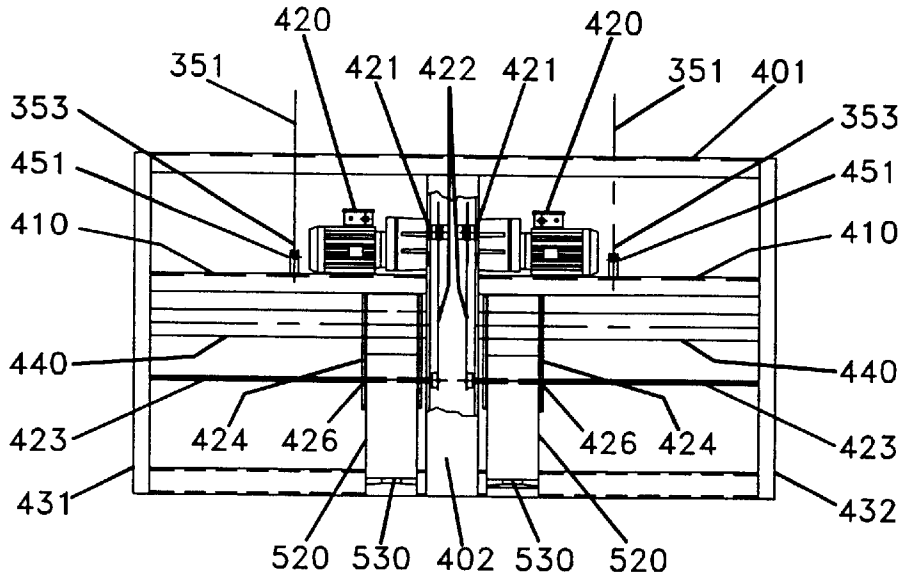
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FIG. 4

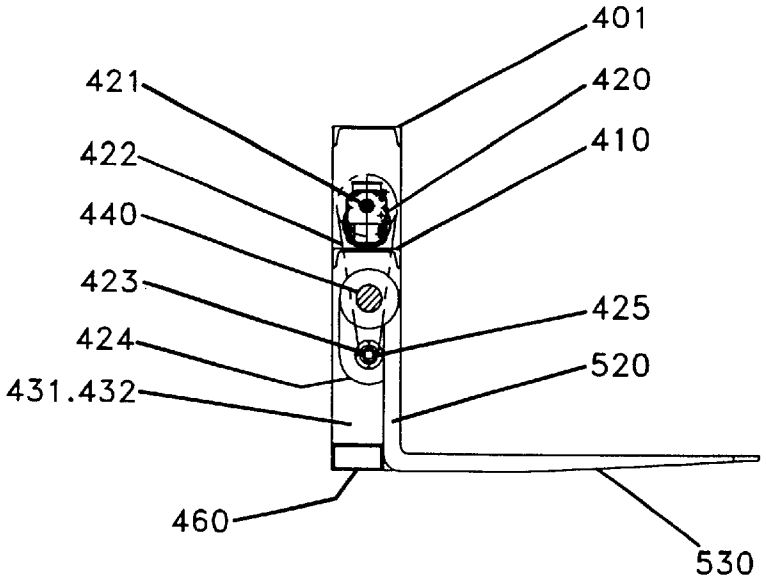
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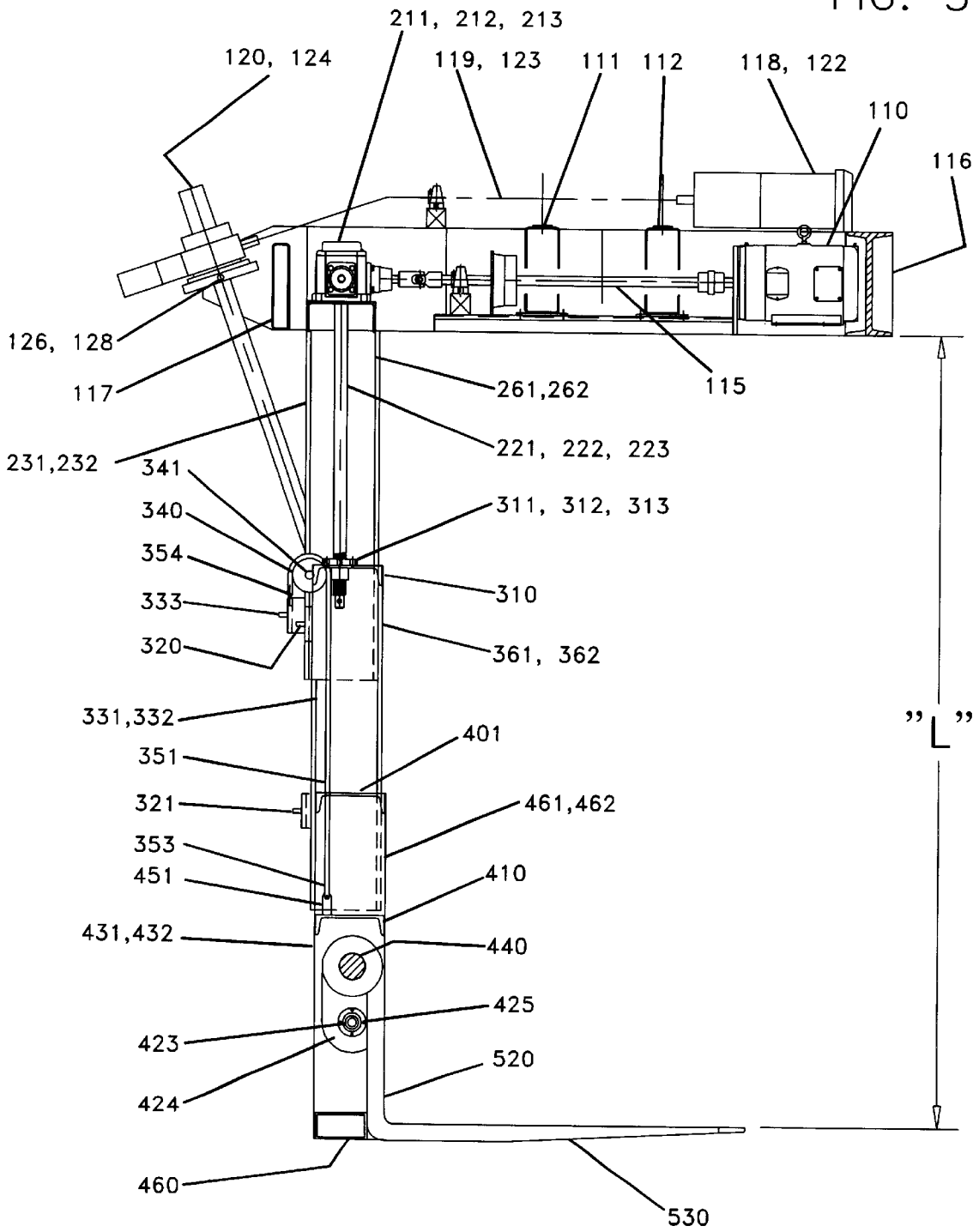
FIG. 5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331,332
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FIG. 6

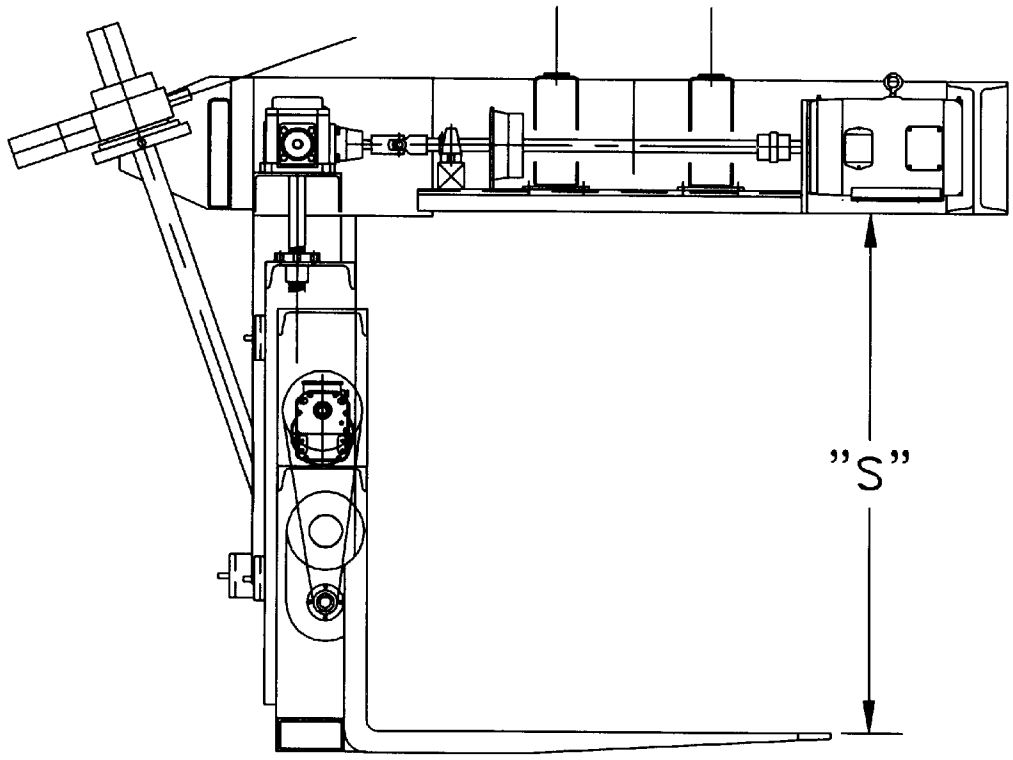
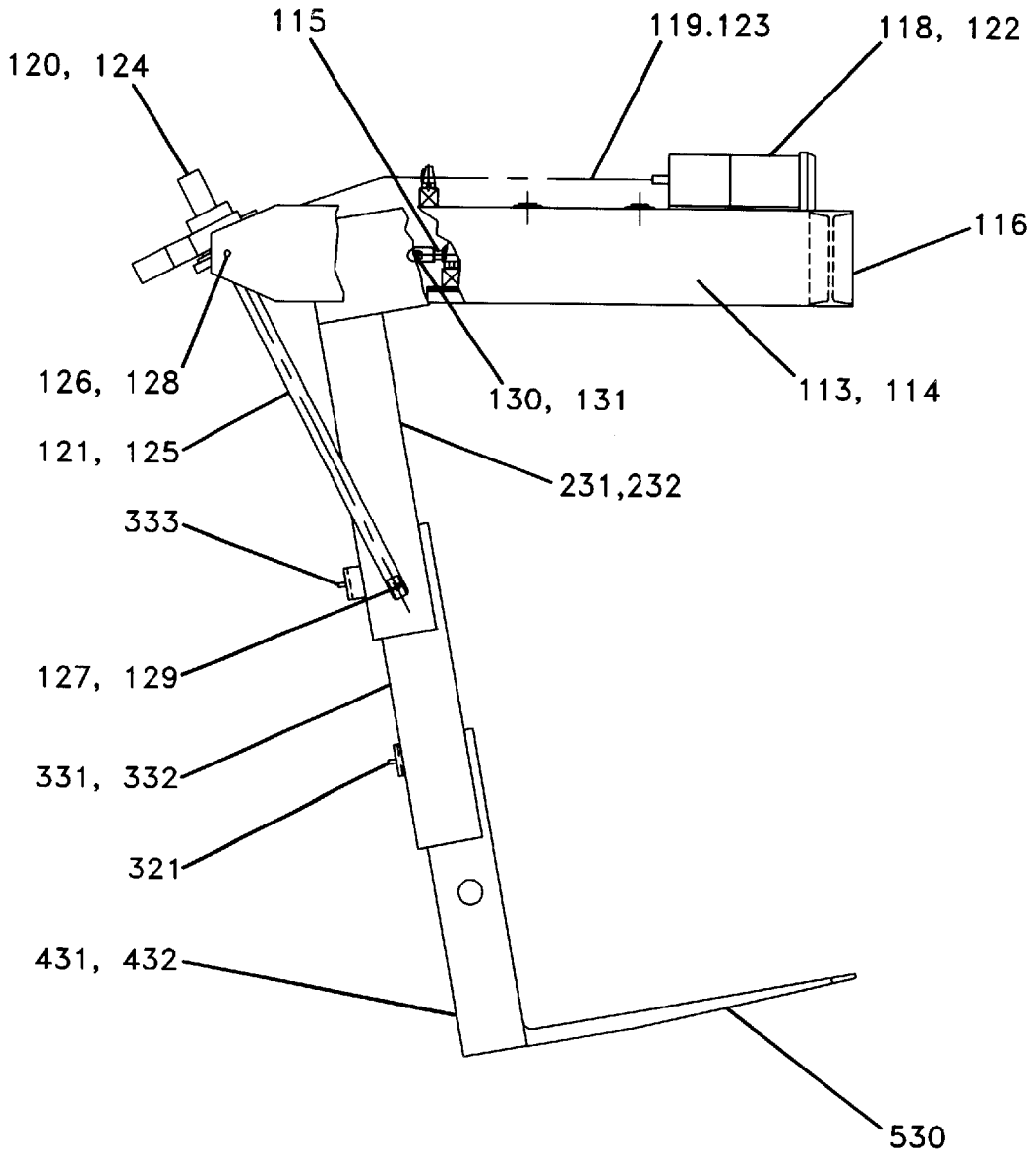


FIG. 7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121, 125
231,232
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331, 332
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SINGLE SIDE ENTRY CONTAINER LIFTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lifting device, and more particularly to a lifting apparatus of adjusting spaced-apart tines to fit a load depending on fork pocket spacing and height of the load.

2. Brief Description of the Prior Art

Fork tines have been used for lifting and moving a load. Typically, fork tines mounted on a frame of a lifting apparatus are spaced-apart from each other. Because a height of the frame fixed, the lifting apparatus is limited to use for lifting and carrying a fixed-sized load. A plurality of lifting apparatuses or a bulky and complicated lifting apparatus have been used for various sized loads.

Moreover, depending on various sizes of the height and the length of the loads, the lifting apparatus having one dimensional adjustment is not enough to lift and move the various sized loads. Furthermore, due to the fork tines being shorter than width of a flatbed trailer, access to containers on the opposite side of the flatbed requires additional time and space to maneuver the forklift.

In efforts of adjusting the distance between fork tines or a height of the frame in the lifting apparatus, U.S. Pat. No. 5,984,050 for a Carriage Suspension For Lift Truck issued to Ronald, U.S. Pat. No. 5,829,948 for a Multipurpose Lift Apparatus and Method issued to Becklund, U.S. Pat. No. 5,758,747 for a Mast Support for Forklift issued to Okazaki et al., U.S. Pat. No. 5,722,511 for a Lifting Vehicle and Method of Operating the Vehicle issued to Wakamiya, U.S. Pat. No. 5,586,619 or a lifting Apparatus issued to Young, U.S. Pat. No. 5,509,774 for a Load Clamping apparatus with an Increased Extent of Vertical Movement issued to Yoo, U.S. Pat. No. 4,657,471 for a Load Lifting Unit For a lift Truck issued to Shinoda et al. disclose various types of lifting apparatuses having the fork tines. These references, however, show mechanisms adjusting only one dimension of the fork tines depending on the size of the load or complicated mechanisms adjusting one or two dimensions of the fork tines and including a tractor or a truck.

In efforts of maintaining the balance of the lifting apparatus, U.S. Pat. No. 4,585,268 for a Overhead Guard For Lift Trucks Of Different Length issued to Downing, U.S. Pat. No. 4,580,650 for a Industrial Truck issued to Matsuda, and U.S. Pat. No. 4,502,709 for an Articulated Loader With Transversely Displaceable Counterweight issued to Schaeff disclose various types of counterbalance using a lifting truck. These references, however, fail to show the counterbalance used in a lifting apparatus lifting loads or containers accessed only from one side of the loads to be picked up and moved to a staging area with the use of a crane.

Regarding screw jack mechanisms, U.S. Pat. No. 5,118,082 for a Electrical Operated Screw-Type Jack issued to Byun, U.S. Pat. No. 4,641,813 for a Dual Automobile Jack For Consumer Use issued to Arzouman, and U.S. Pat. No. 4,609,179 for a Screw Jack issued to Chem et al. disclose typical structures of screw jacks. These references, however, do not show any application for a lifting apparatus.

Therefore, we have noticed that the conventional method and apparatus fail to show a lifting device having a variable range of frame height, tine spacing, and tilt angle of the fork tines. Moreover, when the various sized loads should be located in a limited space or a designated storage location, and are accessed only from one side of the loads to be picked up and moved to a staging area with the use of a crane, the conventional lifting apparatus cannot move within the space and carry the various sized loads into the limited space.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a lifting apparatus suitable to lift and carry all various sized loads.

It is another object of the present invention to provide a lifting apparatus able to load a container into a limited space and a designated storage location.

It is yet another object to provide a lifting apparatus able to adjust any height of a frame or a distance between fork tines.

It is still yet another object to provide a lifting apparatus able to balance when lifting and moving the load accessed only from one side of a flatbed trailer.

It is a further object to provide a lifting apparatus able to access a load within a minimum amount of aisle space.

These and other objects may be achieved by providing a lifting apparatus including a horizontal framework, a telescoping mast coupled to one side of the horizontal framework, a telescoping mast unit having upper, middle, and lower telescoping mast assemblies, and a pair of fork tine assemblies movably mounted on the lower telescoping mast assembly. The horizontal framework is coupled to an overhead bridge crane and is accessible to any load located within a minimum amount of aisle space. A counterbalance is mounted on the other side of the horizontal framework.

The horizontal framework includes a pair of horizontal supporters spaced-apart from each other. Connectors formed on horizontal framework are attached to a bridge crane trolley by securing to the hooks or twist lock connectors of the bridge crane trolley into the connectors.

An electric motor mounted on the horizontal framework is connected by a shaft to an assembly of power screws. The other end of the vertical screw is inserted into a fixed nut on the middle mast assembly.

Upper mast assembly is mounted beneath of the horizontal framework and includes two upper vertical beams spaced-apart from each other and two upper horizontal side bars attached to the spaced-apart upper vertical beams to maintain a distance between the spaced-apart upper vertical beams. Pairs of rails are formed on the upper vertical beams. The vertical screws are rotatably mounted on the upper mast assembly.

A middle mast assembly coupled to the vertical screw of the upper mast assembly through the fixed nut includes two middle vertical beams spaced-apart from each other and two middle horizontal beams attached to spaced-apart middle vertical beams to maintain a distance between the spaced-apart middle vertical beams. Two pairs of rails formed on the two middle vertical beams have a telescoping relationship with each pair of rails of the upper vertical beams.

A lower mast assembly includes two lower vertical beams spaced-apart from each other and lower horizontal beams, each end coupled to the spaced-apart lower vertical beams. A lifting chain is coupled to both the upper and lower mast assemblies through a pulley rotatably mounted on the middle horizontal beam of the middle mast assembly. An anchor is secured to the lower horizontal beam. The lifting chain has one end connected to the anchor and the other end connected to the upper horizontal side bar of the upper mast assembly while a portion of the lifting chain is wound around a peripheral surface of the pulley. A fork tine

assembly is mounted on the lower mast assembly, and two fork tines are spaced-apart from each other by a pair of tine drive motors mounted on the lower mast assembly.

The combined upper, middle, and lower mast assemblies are tilted from the vertical position with the use of two tilt drive power screws. These power screws are rotatably mounted on the horizontal framework. Mechanical power is supplied to the screws through an electric motor and shaft mounted on each side of the horizontal framework. The other end of each tilt drive power screw is rotatably attached to the lower end of the upper mast assembly vertical beams.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

FIG. **1** is a perspective view showing a lifting apparatus according to the principle of the present invention;

FIG. **2** is a partial cross-sectional view illustrating a telescoping mast unit of the lifting apparatus;

FIG. **3** is a partial cross-sectional view illustrating a lower mast assembly of the lifting apparatus;

FIG. **4** is a partial cross-sectional view illustrating a tine unit of the lifting apparatus;

FIG. **5** is a partial cross-sectional view illustrating a maximum height of the telescoping mast unit of the lifting apparatus;

FIG. **6** is a partial cross-sectional view illustrating a minimum height of the telescoping mast unit of the lifting apparatus; and,

FIG. **7** is a partial cross-sectional view illustrating the telescoping mast unit of the lifting apparatus in the tilted position.

DETAILED DESCRIPTION OF THE INVENTION

Hereinafter an embodiment according to the principle of the present invention will be described in detail with reference to accompanying drawings.

Referring now to FIGS. **1** and **2**, a container lifting device **100** includes a horizontal framework **105**, a telescoping mast unit **150** coupled to one side of horizontal framework **105** and including upper, middle, and lower mast assemblies **200**, **300**, **400**, a counterbalance **116**, used to balance the lifting device **100** when empty, coupled to the other side of horizontal framework **105**, a spreader beam **117** connected to the horizontal framework above the telescoping mast unit **150**, and a pair of fork tine assemblies **500** mounted on lower mast assembly **400**. Horizontal framework **105** defines a pair of main beams **111** and **112** spaced-apart from each other and a pair of side beams **113** and **114** secured to both spaced-apart main beams **111** and **112**. Four connectors **101**, **102**, **103**, and **104** are formed on main beams **111** and **112** and connected to a bridge crane trolley not shown. Lifting device **100** is connected to the bridge crane trolley by securing the bridge crane trolley to connectors **101**, **102**, **103**, and **104**, and moves toward and away from the various sized loads located in a limited space or a designated storage location and accesses one side of the loads to pick up and move the loads to a staging area with the use of the crane.

An electric motor **110** is mounted on one of main beams **111** or **112** and a counterbalance **116** in horizontal framework **105**. A longitudinal main shaft **115** extended from electric motor **110** and passing through holes formed on main beams **111** and **112** is coupled to a plurality of power screw jacks **211**, **212**, and **213** through an extended shaft **210**. Vertical screws **221**, **222**, and **223** are rotatably mounted on upper mast assembly **200** and are coupled to extending shaft **210** within power screw jacks **211**, **212**, and **213**.

Upper mast assembly **200** is secured to horizontal framework **105** through two pivots **130** and **131** and defines two upper vertical beams **231** and **232** spaced-apart from each other and having upper ends attached to both said side beams **113** and **114** or main beams **111** and **112**. Referring to FIGS. **1**, **5**, and **7**, an upper horizontal side bar **333** is attached to spaced-apart upper vertical beams **231** and **232** to maintain a distance between spaced-apart upper vertical beams **231** and **232**. Pairs of rails **261** and **262** are formed on upper vertical beams **231** and **232**.

Power screw jacks **211**, **212**, and **213** are mounted on upper mast assembly **200** and disposed to be coupled to extended shaft **210**. Vertical screws **221**, **222**, and **223** are coupled to extended shaft **210** within corresponding power screw jacks **211**, **212**, and **213** and are extended to middle mast assembly **300** and coupled to corresponding fixed nuts **311**, **312**, and **313**. Vertical screws **221**, **222**, and **223** rotate by the rotation of extended shaft **210**, main shaft **115**, and electric motor **110**. One end of vertical screws **221**, **222**, and **223** are coupled to extended shaft **210** within power screw jacks **211**, **212**, and **213** while the other end of vertical screws **221**, **222**, and **223** are inserted into holes formed on middle horizontal beam **310** through fixed nuts **311**, **312**, and **313**. A thread portion formed inside of fixed nuts **311**, **312**, and **313** is coupled to a tooth portion formed on peripheral outside of vertical screws **221**, **222**, and **223**.

Power tilt screw jacks **120** and **124** are mounted on horizontal framework **105** using spreader beam **117** through pivot shafts **126** and **128** and disposed to be coupled to input shafts **119** and **123**. Power tilt screw shafts **121** and **125** rotate by the rotation of input shafts **119** and **123**, and tilt motors **118** and **122**. Power tilt screw jacks are also attached to upper frame members **231** and **232** through pivot shafts **127** and **129**.

Instead of using the power tilt screw jacks **120** and **124**, input shafts **119** and **123** and tilt motors **118** and **122**, a pair of hydraulic or pneumatic cylinders can be attached at one end to spreader beam **117** using pivot shafts **126** and **128** with the opposite end attached to upper frame member pivot shafts **127** and **129**.

Middle mast assembly **300** is coupled to vertical screw **221**, **222**, and **223** of upper mast assembly **200** through fixed nuts **311**, **312**, and **313** and defines two middle vertical beams **331** and **332**, spaced-apart from each other, a middle horizontal beam **310**, and two middle side bars **320** and **321** that are attached to spaced-apart middle vertical beams **331** and **332** to maintain a distance between them. Two pairs of rails **361** and **362** formed on two middle vertical beams **331** and **332** have a telescoping relationship with each of rails **261** and **262** of upper vertical beams **231** and **232**. Rotation of vertical screws **221**, **222**, and **223** causes fixed nuts **311**, **312**, and **313** to move up and down along vertical screws **221**, **222**, and **223** depending on the rotating direction of vertical screws **221**, **222**, and **223**. Since fixed nuts **311**, **312**, and **313** are attached to middle horizontal beam **310** and move along vertical screws **221**, **222**, and **223** middle vertical beams **331** and **332** slidably move along the inside of upper vertical beams **231** and **232**. Thus, middle mast

assembly **300** moves up toward and down from horizontal framework **105**.

As shown in FIGS. **1** through **4**, lower mast assembly **400** defines two lower vertical beams **431** and **432** spaced-apart from each other, lower horizontal beams **401** and **410** each end coupled to spaced-apart lower vertical beams **431** and **432**. Lifting chain **351** is coupled to both upper and lower mast assemblies **200** and **400** through a pulley **340** rotatably mounted on middle horizontal beam **310** of middle mast assembly **300**. Anchor **451** is secured to lower horizontal beam **410**. Lifting chain **351** has one end **353** connected to anchor **451** and the other ends **354** connected to upper horizontal side bar **333** of upper mast assembly **200** while a portion of lifting chain **351** is wound around a peripheral surface of pulley **340**.

When middle mast assembly **300** moves up along vertical screws **221**, **222**, and **223** toward horizontal framework **105**, pulley **340** moves away from upper horizontal side bar **333** and toward horizontal framework **105**. Since lifting chain **351** is wound around pulley **340** mounted on middle horizontal beam **310** of middle mast assembly **300** and rotating about an axis **341** mounted on middle horizontal beam **310** of middle mast assembly **300**, and each end **353** and **354** of lifting chains **351** is coupled to lower horizontal beam **410** of lower mast assembly **400** and upper horizontal side bar **333** of upper mast assembly **200** respectively, lower mast assembly **400** moves toward middle and upper mast assemblies **300** and **200** and horizontal framework **105**. If middle mast assembly **300** moves up toward upper mast assembly **200** and horizontal framework **105**, pulley **340** becomes located on the halfway portion of lifting chains **351**. On the contrary, if middle mast assembly **300** moves down from upper mast assembly **200** and horizontal framework **105**, lower mast assembly **400** moves away from middle and upper mast assemblies **300** and **200** and horizontal framework **105** simultaneously. Pulley **340** becomes located adjacent to a portion of the end **354** of lifting chain **351**.

Therefore, a height of the telescoping mast unit **150** including upper, middle, and lower mast assemblies **200**, **300**, and **400** can be adjusted depending on the height of a container or a load. A maximum height L of the telescoping mast assembly is shown in FIG. **5** while a minimum height S of the telescoping mast assembly is shown in FIG. **6**. Rail **461** of lower vertical beam **431** slides into inside of rail **361** of middle vertical beam **331** which slides into inside of rail **261** of upper vertical beam **231** while rail **462** of lower vertical beam **432** slides over the outside surface of rail **362** of middle vertical beam **332** which slides over the outside surface of rail **262** of upper vertical beam **232** during adjusting the height of the telescoping mast unit **150**. The height of lifting device **100** is adjusted by electric motor **110** and the telescoping mast unit **150** including upper, middle, and lower mast assemblies **200**, **300**, and **400**. Instead of horizontal motor **110**, main shaft **115**, power screw jacks **211**, **212**, and **213**, and extended shaft **210**, a pair of hydraulic or pneumatic cylinders can be mounted on the horizontal frame assembly **105** or upper mast assembly **200**. The cylinder is connected to lower mast assembly **400** and middle mast assembly **300** with lifting chains **351**.

Referring now to FIGS. **2–5**, a tine unit **500** is mounted on lower mast assembly **400**. A pair of tine drive motors **420** are mounted on lower horizontal beam **410** of lower mast assembly **400**. Longitudinal tine screw **423** is rotatably mounted on spaced-apart lower vertical beams **431** and **432** and internal vertical beam **402** and is connected to tine drive motor **420** through a shaft **421** and a pulley and belt **422**. A traveling frame **424** having a threaded nut **425** and two spaced-apart guide protrusions **426** is coupled to a thread portion of tine screw **423** and moves along an axis of tine screw **423**. Two ends of tine screw **423** are fixed to spaced-apart lower vertical beams **431** and **432** and internal vertical beam **402** respectively after tine screw **423** is inserted into threaded nut **425** attached to traveling frame **424**. Top portion of tine **520** is located between two spaced-apart guide protrusions **426** of traveling frame **424**. Tine **520** slides along tine axle **440** by movement of traveling frame **424** and moves in the same direction of guide protrusions **426** of traveling frame **424**. Tine body supporter **460** is disposed to support tine **520** during loading a container or a load on tine extensions **530** of tine **520** thereby preventing tine **520** from rotating about the axis of tine axle **440**.

Instead of using the tine screw **423**, threaded nut **425**, pulley and belt **422**, shaft **421** and the tine drive motor **420**, a pair of hydraulic or pneumatic cylinders can be attached at one end to the traveling frame **424** with the opposite end attached to lower vertical beams **431** and **432**.

Depending on the fork pocket spacing of the container, the distance between tines **520** can be adjusted by tine unit **500** to align with the container fork pockets when tines **520** move along tine axle **440**. Therefore, the height and spacing of the fork tines on lifting device **100** are adjusted by electric motor **110** and tine drive motor **420**, the telescoping mast unit vertically moving by electric motor **110** and lifting chains **351** and tine unit **500** by tine drive motor **420** respectively depending on the height and fork pocket spacing of the container. Before a container is loaded on tines **520**, the lifting device **100** moves toward the container by the bridge crane trolley. While approaching the container, the height and fork tine spacing of the lifting device **100** are adjusted. The container loaded on the tine **520** is carried by the bridge crane trolley coupled to lifting device **100**.

Since lifting device **100** accesses one side of the loads or containers to pick up and move the loads to a staging area with the use of the crane, lifting device **100** does not have to be adjusted to the width of the container, and can move toward and away from the various sized loads located in a limited space or a designated storage location.

As described in the above, there are advantages in the lifting device **100** for adjusting the height and fork tine spacing of the lifting device **100** according to the principle of the present invention in that the lifting device **100** includes a horizontal framework **105** having a connection to a bridge crane trolley and an electric motor **110** mounted on the horizontal framework **105**, a telescoping mast unit **150** coupled to one side of the horizontal framework **105** and having upper, middle, and lower mast assemblies **200**, **300**, and **400** adjusting a height of the lifting device **100**, a tine unit **500** adjusting a center to center tine **520** spacing of the lifting device **100**, and counterbalance **116** coupled to the other side of the horizontal framework **105** thereby giving the lifting device **100** a great amount of adjustability to handle various unit load heights and fork pocket spacing and allowing the lifting device **100** to load containers having different dimensions into a fixed space or even a narrow space.

What is claimed is:

1. A lifting device, comprising:

a horizontal framework;

a telescoping mast unit having a plurality of telescoping mast assemblies, coupled to said horizontal framework, approximately perpendicular to said horizontal framework, wherein said telescoping mast unit vertically moves toward and away from said horizontal framework;

a connector connected to the horizontal framework for suspending the device;

a fork tine unit mounted on one of said telescoping mast assemblies, having a pair of tines spaced-apart from each other;

a power source;

a screw coupled to said power source, coupling said power source to one of said telescoping mast assemblies wherein said telescoping mast unit telescopes through said power source; and,

a mast tilting unit wherein said telescoping mast unit pivots in relation to said horizontal framework.

2. A lifting device, comprising:

a horizontal framework;

a telescoping mast unit having a plurality of telescoping mast assemblies, coupled to said horizontal framework, approximately perpendicular to said horizontal framework, wherein said telescoping mast unit vertically moves toward and away from said horizontal framework;

a fixed nut mounted on said telescoping mast unit;

a vertical motor connected rotationally to a vertical screw wherein said vertical screw moves within said fixed nut during rotation;

a power screw jack coupling said vertical motor to said vertical screw;

a fork tine unit mounted on one of said telescoping mast assemblies, having a pair of tines spaced-apart from each other;

a power source; and,

said screw coupled to said power source, coupling said power source to one of said telescoping mast assemblies wherein said telescoping mast unit telescopes through said power source.

3. The lifting device of claim **2**, wherein said telescoping mast unit further comprises a pulley rotatably mounted on said middle mast assembly, said chain wound around said pulley.

4. The apparatus of claim **3**, wherein said fork tine unit comprises a tine drive motor connected to said tines wherein said tine drive motor moves said tines toward and away from each other.

5. The apparatus of claim **4**, wherein said fork tine unit further comprises a tine cylinder connecting said tines to said lower mast assembly.

6. The lifting device of claim **4**, wherein said fork tine unit further comprises:

a tine screw connected to said tine drive motor, rotatably mounted on said lower mast assembly;

a guide frame coupled to a thread portion of said tine screw, moving along said tine screw while said tine screw rotates by said tine drive motor; and

a guide protrusion extended from said guide frame, moving said tines.

7. The lifting device of claim **6**, wherein said fork tine unit further comprises:

a tine hole formed on said tine; and

a tine axle inserted into said tine hole, fixed on said lower mast assembly, being approximately parallel to said tine screw.

8. The apparatus of claim **7**, wherein said fork tine unit further comprises a tine body supporter mounted on said lower mast assembly, disposed to support said tine and prevent said tine from rotating about an axis of said tine axle.

9. The lifting device of claim **8**, further comprising:

a first and second side of said horizontal framework substantially opposite one another wherein said telescoping mast unit connects to said first side; and,

a counterbalance connected to said second side wherein the lifting device remains substantially balanced when not lifting a load.

10. The lifting device of claim **9**, wherein said mast tilting unit comprises:

a plurality of power screw jacks mounted rotatably on said horizontal framework;

at least a motor to power said power screw jacks;

at least an extended shaft connecting said motor to said power screw jacks; and,

a plurality of tilt screws coupled to said plurality of power screw jacks, attached rotatably to said upper mast assembly.

11. The lifting device of claim **9**, wherein said mast tilting unit comprises:

a cylinder mounted on said horizontal framework; and,

a shaft coupled to said cylinder and to said upper mast assembly wherein said upper mast assembly tilts through said cylinder.

12. A process for lifting containers, comprising the steps of:

providing a lifting device comprising a horizontal framework, a telescoping mast unit having a plurality of telescoping mast assemblies, coupled to said horizontal framework, approximately perpendicular to said horizontal framework, wherein said telescoping mast unit vertically moves toward and away from said horizontal framework, a connector connected to the horizontal framework for suspending the device, a fork tine unit mounted on one of said telescoping mast assemblies, having a pair of tines spaced-apart from each other, an upper mast assembly connected to said horizontal framework by a mast tilting unit, a middle mast assembly telescoped into said upper mast assembly and connected to said upper assembly through a vertical screw connected between said middle mast assembly and a vertical motor wherein said vertical motor may turn said vertical screw, and, a lower mast assembly telescoped into said middle mast assembly and connected to said upper mast assembly through a chain supported by said middle mast assembly wherein vertical movement of said middle mast assembly results in vertical movement of said lower mast assembly; and,

initiating said lifting device.

13. The process of claim **12**, wherein the lifting device further comprises a mast tilting unit wherein said telescoping mast unit pivots in relation to said horizontal framework.

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